

Claims

What is claimed is:

1. A birefringent device of substantially uniform thickness less than about 10 microns, suited to propagate an incident radiation and being suitable for operating in a wavelength range about a central wavelength, said device comprising:

a base substrate;

a layer of periodic index regions of alternating refractive indices applied to a first surface of said base substrate, said layer having a periodicity of less than the central wavelength; and,

a cap substrate located substantially adjacent to said layer distal to said base substrate,

wherein said device is suitable to produce an arbitrary phase retardation between 0 and  $2\pi$  phase.

2. The device of Claim 1, wherein said base substrate includes at least one optically active material.

3. The device of Claim 2, wherein said base substrate comprises a metallic mirror.
4. The device of Claim 2, wherein said base substrate comprises at least one dielectric material.
5. The device of Claim 2, wherein said cap substrate includes at least one optically active material.
6. The device of Claim 5, wherein said cap substrate comprises a metallic mirror.
7. The device of Claim 5, wherein said cap substrate comprises a dielectric material.
8. The device of Claim 1, wherein said layer of periodic index regions of alternating refractive indices includes alternating dielectric strips suitable as a high index material and air gaps suitable as a low index material.

9. The device of Claim 1, wherein said layer of periodic index regions includes at least one region of tunable indices.

10. The device of Claim 9, wherein said at least one region includes liquid crystals.

11. The device of Claim 10, wherein said at least one region is substantially aligned with the structure of said periodic regions.

12. The device of Claim 10, wherein said liquid crystals are suitable for tuning by applying a voltage.

13. The device of Claim 1, wherein said base substrate, said cap substrate, and the high refractive index of said layer are substantially index matched.

14. The device of Claim 1, further comprising an outer coating.

15. The device of Claim 14, wherein said outer coating is suitable for protecting the device from at least one of environmental exposure and scratching.

16. The device of Claim 14, wherein said outer coating is index matched with at least one of said base substrate and said cap substrate.

17. The device of Claim 1, wherein said layer of periodic index regions includes a high refractive index at least twice the low refractive index.

18. The device of Claim 1, wherein said layer of periodic index regions includes a high refractive index at least thrice the low refractive index.

19. The device of Claim 1, wherein at least one of said base substrate, said layer of periodic index regions, and said cap substrate are designed to modify the back reflected portion of the electromagnetic radiation incident upon the device.

20. The device of Claim 19, wherein said base substrate, said layer of periodic index regions, and said cap substrate are designed such that the back reflected portions of the incident radiation substantially cancel.

21. The device of Claim 20, wherein substantially canceling comprises an overall reflection of less than about 5 percent of the incident radiation.

22. The device of Claim 20, wherein substantially canceling comprises an overall reflection of less than about 2.5 percent of the incident radiation.

23. The device of Claim 20, wherein substantially cancel refers to an overall reflection of less than about 1 percent of the incoming radiation.

24. The device of Claim 1, further comprising at least one anti-reflection coating on said base substrate distal to said layer of periodic index regions.

25. The device of Claim 24, further comprising at least one anti-reflection coating on said cap substrate distal to said layer of periodic regions.

26. The device of Claim 1, wherein said alternating refractive indices alternates in at least one-dimension.

27. The device of Claim 1, wherein said alternating refractive indices alternates in at least two-dimensions.

28. The device of Claim 1, further comprising at least a second layer of periodic index regions of alternating high and low refractive indices applied to a surface of said cap substrate distal to said layer of periodic index regions, said second layer having a periodicity of less than the central wavelength; and at least a second cap substrate located substantially adjacent to said second layer distal to said cap substrate.

29. The device of Claim 1, wherein said layer of periodic index regions is substantially pixelized, and suitable for selectively orienting at least one given pixel to at least one preferred orientation.

30. The device of Claim 1, further comprising at least one etch stop positioned substantially adjacent to said base substrate and suitable for controlling formation of said layer of periodic index regions.